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Study and Analysis of Throughput, Delay and Packet Delivery Ratio in MANET for Topology Based Routing Protocols (AODV, DSR and DSDV)

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Abstract: *Due to mobility constraints and high dynamics, routing in Mobile Ad-Hoc Network is a very challenging task. In this work, we evaluate the performance of the routing protocols in mobile network environment. The objective of this work is to assess the applicability of these protocols in different mobile traffic scenarios. Here we considered Topology based routing protocols. In Topology-based routing protocols, both proactive (DSDV) and reactive protocols (AODV, DSR) have been considered for the study. Performance metrics such as packet delivery ratio, throughput, and end-to-end delay are evaluated using NS-2. Simulation results shows position based routing protocols gives better performance than topology based routing protocols.*

1. INTRODUCTION

Mobile Ad hoc Networks (MANET) has become an exciting and important technology in recent years because of the rapid proliferation of wireless devices. A mobile ad-hoc network consists of mobile nodes that can move freely in an open environment. Communicating nodes in a Mobile Ad-hoc Network usually seek the help of other intermediate nodes to establish communication channels. A Mobile Ad-hoc Network is a group of wireless mobile computers in which nodes cooperate by forwarding packets for each other to allow them to communicate beyond direct wireless transmission range. Application such as military exercises, disaster relief, and mine site operation may benefit from ad-hoc networking, but secure and reliable communication is a necessary prerequisite for such applications.

The characteristics of these networks are summarized as follows:

- Communication via wireless means (Nodes can perform the roles of both hosts and routers)
- No centralized controller and infrastructure.
- Intrinsic mutual trust.
- Dynamic network topology.
- Frequent routing updates.

1.1. Advantages and Applications

The following are the advantages of MANETs:

- They provide access to information and services
- Regardless of geographic position.
- These networks can be set up at any place and time.
- Some of the applications of MANETs are
- Military or police exercises.
- Disaster relief operations.
- Mine cite operations.
- Urgent Business meeting

2. MANET ROUTING PROTOCOLS

This section describes various routing protocols [2] that have been chosen to simulate and analyze.

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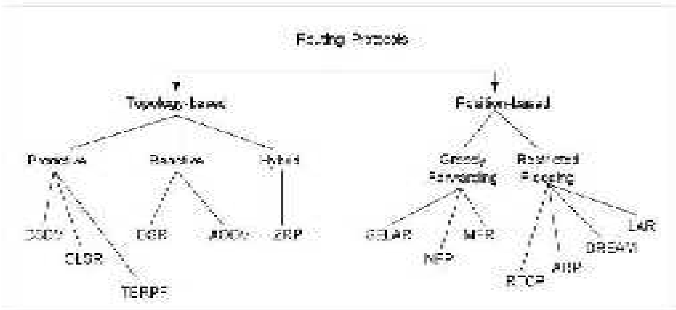

2.1. Topology based routing protocols
Topology based routing protocols [2] depend on the information about existing links in the network and use them to perform packet forwarding. The topology based routing protocols can be further subdivided into proactive, reactive, and hybrid protocols.

Proactive (table-driven) routing protocols [3-4] are similar to the connectionless schemes of traditional datagram networks. These protocols employ classical routing strategies such as distance-vector (e.g. DSDV) or link-state (e.g. OLSR) routing and any changes in the link connections are updated periodically throughout the network. Proactive protocols maintain routing information about the available paths in the network even if these paths are not currently used. The main disadvantage of these protocols is the maintenance of unused paths may occupy an important part of the available bandwidth if the network topology changes frequently. However, proactive protocols may not always be suitable for highly mobile networks such as MANETs.

Reactive (on-demand) routing protocols [3-4] (e.g. AODV, DSR) employ a lazy approach whereby mobile nodes only discover routes to destinations on-demand. These protocols maintain only the routes that are currently in use, thus reducing the burden on the network when only a few of all available routes is in use at any time. Reactive protocols often consume less bandwidth than proactive protocols, but the delay in determining a route can be substantially large. In reactive protocols, since routes are only maintained while in use, it is typically required to perform a route discovery process before packets can be exchanged between nodes. Therefore, this leads to a delay for the first packet to be transmitted. Another disadvantage is that, although route maintenance is limited to the routes currently in use, it may still generate a significant amount of network traffic when the network topology changes frequently. Finally, packets transmitted to the destination are likely to be lost if the route to the destination changes.

Hybrid routing protocol (ZRP)[3] combines both proactive and reactive approaches to achieve a higher level of efficiency and scalability.

However, even a combination of both approaches still needs to maintain at least those network routes that are currently in use. Therefore, limiting the amount of topological changes, that can be tolerated within a given amount of time. However, MANET differs from other networks by its highly dynamic topology. Many simulation result showed that most of the topology based routing protocols suffer from highly dynamic nature of vehicular node mobility because they tend to have poor route convergence and low communication throughput. Position based routing protocols has been identified as a more suitable routing protocols for MANETs to give better performance and exhibit scalability and robustness against frequent topological changes.

2.1.1 Destination Sequenced Distance Vector – DSDV
DSDV [3] is a hop –to –hop distance vector routing protocol. In this protocol, each node has a routing table that stores the next hop, number of hops for all the reachable destinations. Each node broadcast routing updates periodically. The advantage of DSDV over traditional distance vector routing protocols is that DSDV guarantees loop-free routing.

2.1.2 Dynamic Source Routing (DSR)
DSR [3] allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration. The protocol is composed of the two main mechanisms of “Route Discovery” and “Route Maintenance”, which work together to allow nodes to discover and maintain routes to destinations in the ad hoc network. An advantage of DSR is that nodes can store multiple routes in their route cache, which means that the source node can check its route cache for a valid route before initiating route discovery and if a valid route is found there is no need for route discovery.

2.1.3 Ad Hoc on Demand Distance Vector- AODV
The ad hoc on demand distance vector (AODV) [4] is based on distance vector routing algorithm. However, unlike distance vector, it is a reactive protocol i.e. it requests the route when needed. It does not require nodes that maintain routes for destinations, which are not actively used in communication. The features of AODV routing protocol are loop-free routing and immediate notification is to be sent to the affected nodes on link breakage. The algorithm uses various messages to maintain and discover links. These are route request (RREQ), route reply (RREP), and route error (RERR).

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When a source node desires to establish a communication session, it initiates a path- discovery process. The source node broadcasts a RREQ packet with its IP address, broadcast ID (BrID) and sequence numbers of source and destination. While the BrID and IP address is used to uniquely identify each request. Receiving node set the backward pointer to the source and generates a RREP packet if it is the destination.

Route Table Management
The route table in AODV needs to keep track of the following information:

- Destination IP address: - In this field IP address for destination node is stored.
- Destination Sequence Number: - The sequence number for the particular destination.
- Next Hop: - The next neighbour of a particular node in the direction of destination.
- Hop Count: - Number of hops to the destination.
- Active Neighbor List: - Neighbour nodes, which are actively using this route entry.

2.1. Position based routing protocols
Position is one of the most important data for vehicles. In MANET each vehicle wishes to know its own position as well as its neighbor vehicle's position. A routing protocol using position information in known as the position based routing protocol [5][7]. Position based routing protocols the information about the physical location of participating vehicles be available. This position can be obtained by periodically transmitted control messages or beacons to the direct neighbors. A sender can request the position of a receiver by means of a location service. Position based routing protocols are more suitable for MANETs since the Mobiles nodes are known to move along established paths. Since routing tables are not used in these protocols therefore no overhead is incurred when tracing a route.

In MANETs, route is composed of several pair of mobiles nodes (communication links) connected to each other from the source to the destination. If we know the current information of node involved in the routes, we can predict their positions [6] in the near future to predict the link between each pair of nodes in the path. MANET is a self- organizing mobile ad -hoc network in which to acquire the position information of neighbouring nodes, each node periodically exchanges a list of all neighbours it can reach in one hop, using a HELLO control message or a beacon that contains its ID, location, speed, and a timestamp.

One of the main advantages of using position based routing protocol is that it's characteristic of not requiring maintenance of routes, which is very appropriate for highly dynamic networks such as MANETs.

3. SIMULATION RSULTS AND OBSERVATIONS

Mobiles are deployed in a 1000m*1000m area. The simulation parameters are as follows:

Area Size	800m x 800m
Number of nodes	50, 100,150,200,250
Maximum node speed	15m/s
Simulation Time	15s
Data Rate	4 packets per second
Packet Size	512
Buffer Size	50 packets
Number of connections	2
Communication Range	50m

Experimental Results
Scenario-1

Pause time	AODV			DSR			DSDV		
	1	2	3	1	2	3	1	2	3
20	377.94	67.48	98.873	369.37	61.37	94.62	286.15	60.040	51.962
40	349.92	107.28	99.00	341.94	81.056	94.46	234.96	44.381	47.333
60	324.54	124.265	104.98	324.24	104.92	94.234	206.64	26.556	37.456
80	376.67	147.912	107.24	302.71	122.16	94.00	184.77	18.135	24.435

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4. RESULTS

The protocols are evaluated for packet delivery ratio, throughput, and average end-to-end delay.

Throughput comparisons

We know that throughput increases when connectivity is better. It can be observed that the performance of the DSDV reduces drastically while AODV is slightly better among the three and DSR is better than DSDV.

4.1 Throughput

It is defined as the total number of packets delivered over the total simulation time. The throughput comparison shows that the three algorithms performance margins are very close under traffic load of 50 and 100 nodes in MANET scenario and have large margins when number of nodes increases to 200.

Mathematically, it can be defined as:

Throughput= N/1000

Where N is the number of bits received successfully by all destinations.

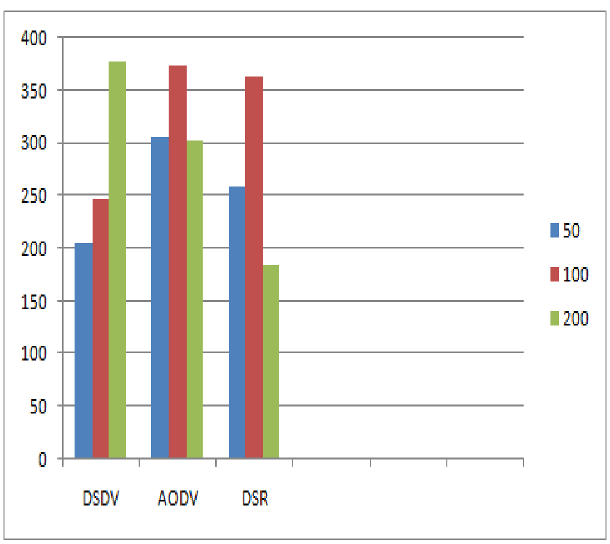

Figure 1: Throughput Comparison

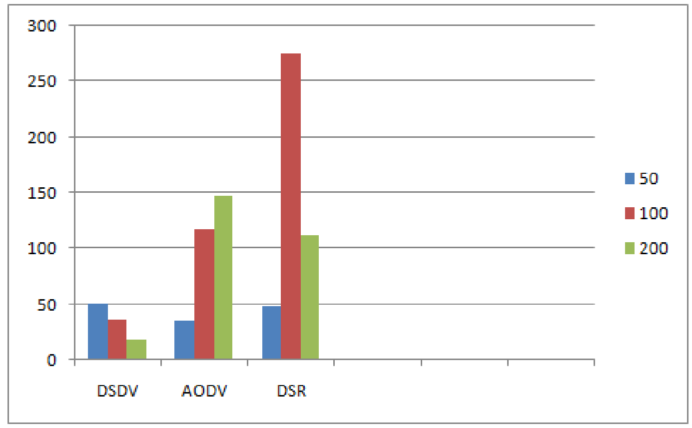

Figure 2: End to End Delay

Above graphs shows the variation of the delay. AODV consistently shows the highest delay. DSDV has the lowest delay as compared to the DSR and DSDV. One factor can be that it have less throughput (Number of packets delivered per unit time) so it is having the less delay

4.2 End to end delay

The average time it takes a data packet to reach the destination. This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue. This metric is calculated by subtracting time at which first packet was transmitted by source from time at which first data packet arrived to destination. Mathematically, it can be defined as:

Avg. EED=S/N

Where S is the sum of the time spent to deliver packets for each destination, and N is the number of packets received by the all destination nodes.

4.3 Packet delivery ratio

Packet delivery ratio is defined as the ratio of data packets received by the destinations to those generated by the sources. Mathematically, it can be defined as:

PDR= $S1 \div S2$

Where, $S1$ *is* the sum of data packets received by the each destination and $S2$ *is* the sum of data packets generated by the each source. Graphs show the fraction of data packets that are successfully delivered during simulations time versus the number of nodes. Performance of the DSDV is reducing regularly while the PDR is increasing in the case of DSR and AODV. AODV is better among the three protocols.

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5. CONCLUSIONS

In this paper we find out the performance of three topology based routing protocols (both reactive and proactive) like DSDV, AODV and DSR by increasing numbers of nodes. Here, we find out the performance on the basis of throughput, delay and packet delivery ratio. By comparing these protocols on the basis of various performance metrics we have reached to a conclusion that reactive topology based protocols are better than proactive topology based routing protocols.

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References

[1] S. Toumpis, Wireless ad-hoc networks, in: Vienna Sarnoff Symposium, Telecommunications Research Center, and April2004.

[2] Akshai Aggarwal, Savita Gandhi and Nirbhay Chaubey "A Study of Secure Routing Protocol in Mobile Ad hoc Networks" in Proceedings of National Conferences on Advancement in Wireless Technology and Applications, 18-19 December 2008, SVNIT, Surat, India

[3] Nor Surayati Mohamad Usop, Azizol Abdullah, Ahmad Faisal Amri Abidin. Performance Evaluation of AODV, DSDV & DSR Routing Protocol in Grid Environment. *IJCSNS, VOL.9* No.7,pp 261-268, July 2009.

[4] Perkins, C.; Belding-Royer, E .; Das, S. (July 2003)"Adhoc on- Demand Distance Vector (AODV) Routing".

[5] M. Mauve, J. Widmer and H. Hartenstein, (2001) "A survey on position-based routing in mobile ad hoc networks", IEEE Network Magazine, *Vol.* 15, Issue No.6, pp. 30-39.

[6] S. Kalhor, M. Anisi, A. Haghighat: A New Position-based Routing Protocol for Reducing the Number of Exchanged Route Request Messages in Mobile Ad-hoc Networks, in Proceedings of 2nd International Conference on Systems and Networks Communications (ICSNC 2007), IEEE, 2007, p. 13

[7] R. Al-Ani, "Simulation and performance analysis evaluation for variant MANET routing protocols", International Journal of Advancements in Computing Technology, Volume 3, Number 1, February 2011

[8] A. Kumar Sharman and N. Bhatia, "Behavioral study of MANET routing protocols by using NS-2", IJCEM International Journal of Computational Engineering & Management, Vol. 12, April 2011 ISSN (Online): 2230-7893

[9] http://www.isi.edu/nsnam/ns/tut orial/

[10] Ad Hoc Wireless Networks Architectures and Protocols: C. Siva Ram Murthy; B. S. Manoj